Simulation Based Acquisition for the Artemis Program

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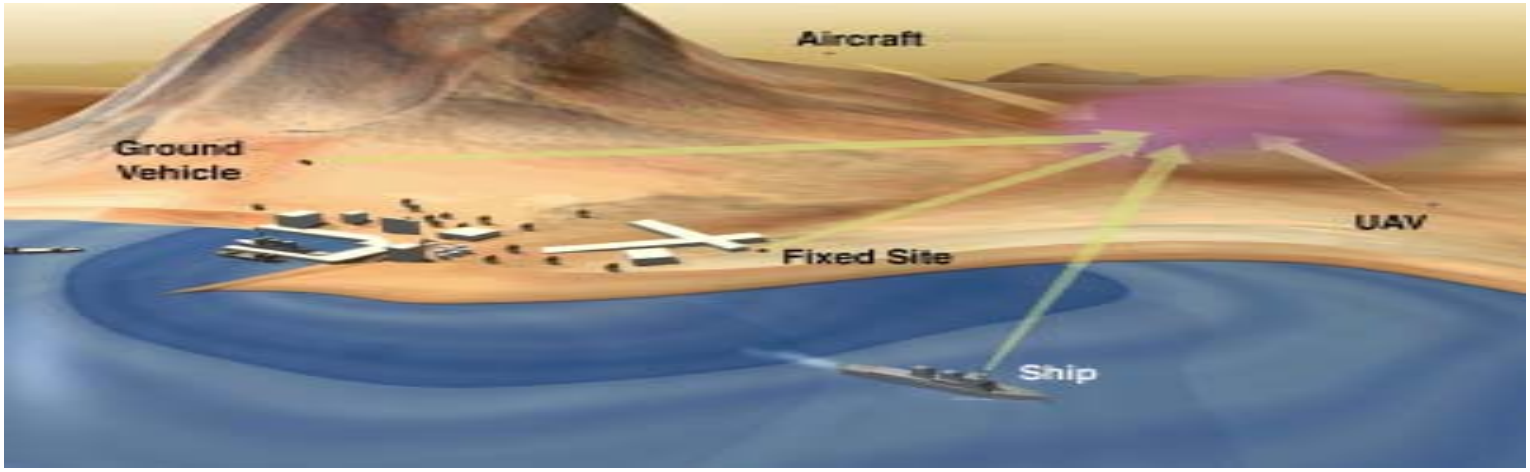
Artemis System Overview



- Active Standoff Chemical Warfare (CW) detection system
- Near-real-time identification of CW agent vapors and aerosols
- Autonomous operation
- Detailed mapping and tracking of threat clouds
- Modular design for ease of integration
- Warfighter benefits
  - Maximum warning and battlefield awareness
  - Enables preventive measures versus countermeasures

What Is Simulation-Based Acquisition (SBA)*?

- SBA is an Acquisition Process in Which DoD and Industry are Enabled by Robust, Collaborative Use of Simulation Technology That is Integrated Across Acquisition Phases and Programs.
- SBA is a Revolutionary Acquisition Initiative
  - Emphasizes modeling and simulation (M&S) as a primary tool
  - M&S applied and sustained throughout the life cycle
  - Virtual life cycle product validation before production
  - Enables iterative development and integrated product and process development
- Major Impact on Test and Evaluation Culture and Purpose
  - Digital representations are tested
  - Physical test articles are primarily for model verification and validation

* From NAVAIR Acquisition Guide – http://www.ntsc.navy.mil/Resources/Library/Acqguide/sba.htm

Why Use SBA on the Artemis Program?

- SBA Can Significantly Reduce Overall Program Risk and Cost By:
  - Analyzing user requirements
  - Understanding cost and risk
  - Developing a performance specification that directly reflects user needs
  - Evaluating system design prior to “bending metal”
  - Applying virtual testing prior to full systems test
  - Developing a robust training system
  - Supporting production qualification testing

SBA provides the methodology to successfully manage user expectations throughout the lifecycle of the program.

The SBA Process Utilizes A Variety of Simulation Tools

- The Total Ownership Cost (TOC) Model
  - System model for evaluating cost of various technologies
  - Provides a ROM TOC for the Warfighter
- The Combat Development Model
  - Integrated, battlefield employment model for evaluating various employment concepts and scenarios
- The Executable Model
  - High fidelity system model built upon a detailed system architecture
  - Validates architecture by implementing desired use cases
  - Provides system performance predictions to support system specification development, design tradeoffs, virtual testing and system data analysis
- Training Tool
  - Integrates the combat development model with war-game simulators to train the Warfighter

Briefing will emphasize Executable Model development

System Architecture Development Follows Strict Development Protocols

Definition

Architecture: The structure of components, their relationships, and the principles and guidelines governing their design and evolution over time.

DoD Integrated Architecture Panel
1995, based on IEEE STD 610.12

Terminology

Framework: Guideline for a common approach for system architecture development

Architecture Views: Perspectives used to develop the system architecture (operational, systems, technical)

Use Cases: Scenarios

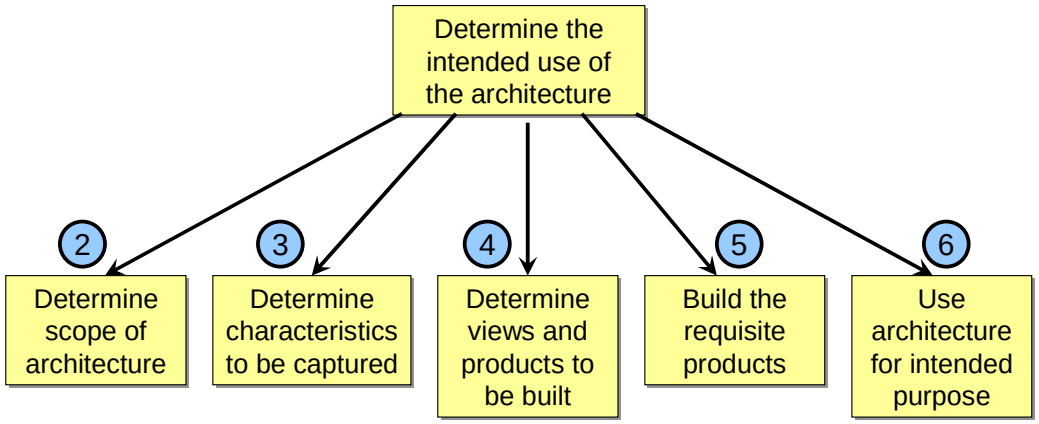
Views

Operational View: Tasks and activities required to accomplish missions

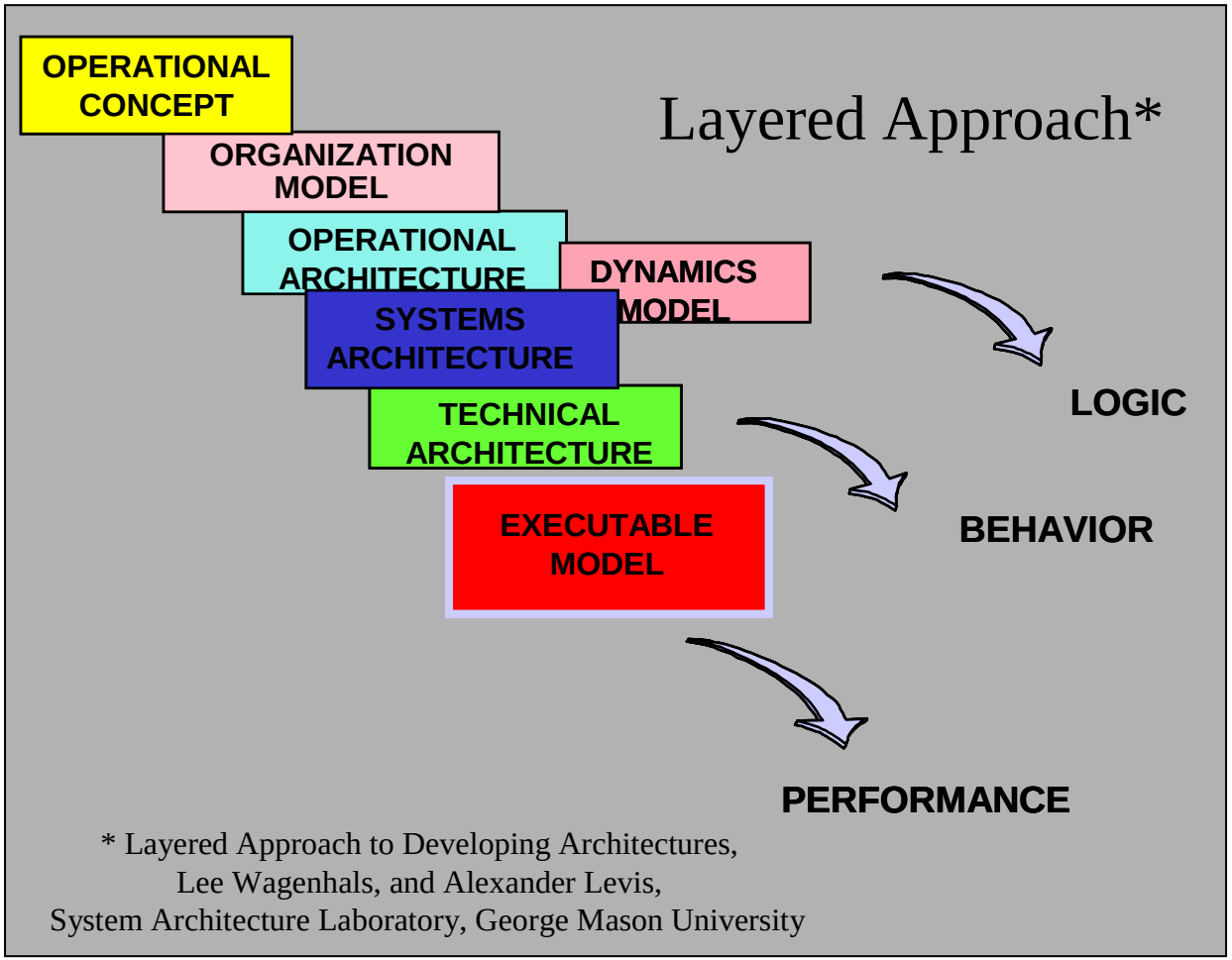
Systems View: Systems and interconnections providing functions

Technical Standards View: Minimal set of rules governing the interaction of elements

Process



Layered Development Approach Insures Architecture Will Support Executable Model Development



* Layered Approach to Developing Architectures,
Lee Wagenhals, and Alexander Levis,
System Architecture Laboratory, George Mason University

Stage 1

Domain information is collected

Emphasis is on operational views

Products: Structural diagrams

Stage 2

Develop the system and technical views

Emphasis is on systems, system interconnections, networks and performance parameters

Products: Behavior diagrams

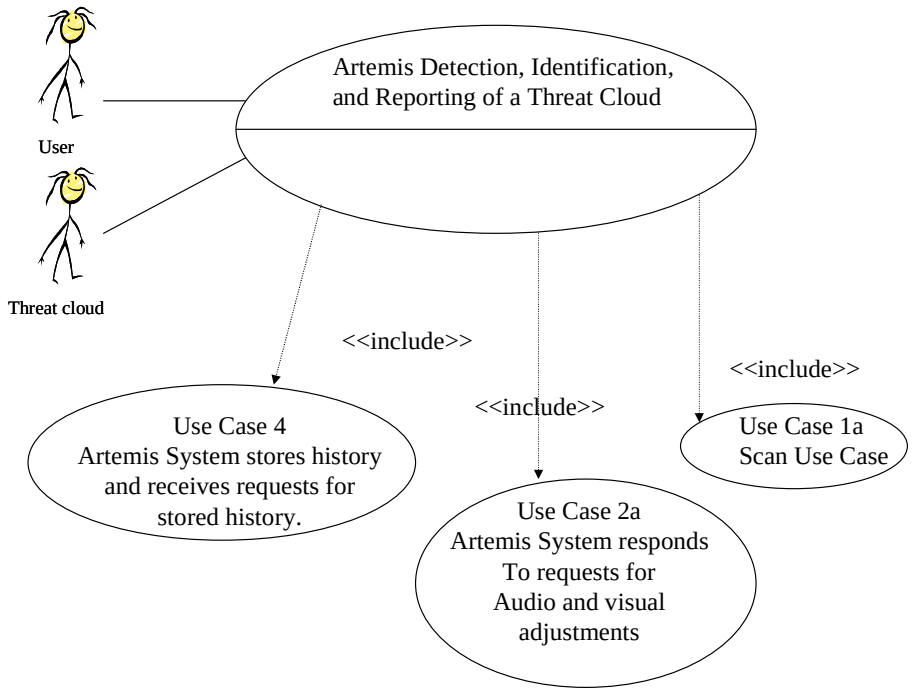
Stage 3

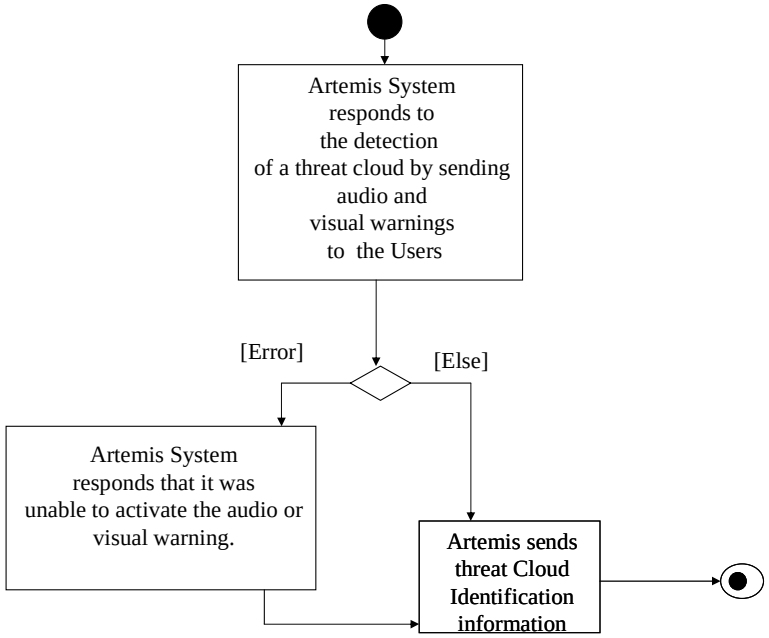
Develop the executable model

Emphasis is on the analysis of system performance and the dynamics of the architecture

Product: Executable Model

Architecture Use Case Development Example (1)
Detection, Identification and Reporting a Threat Cloud

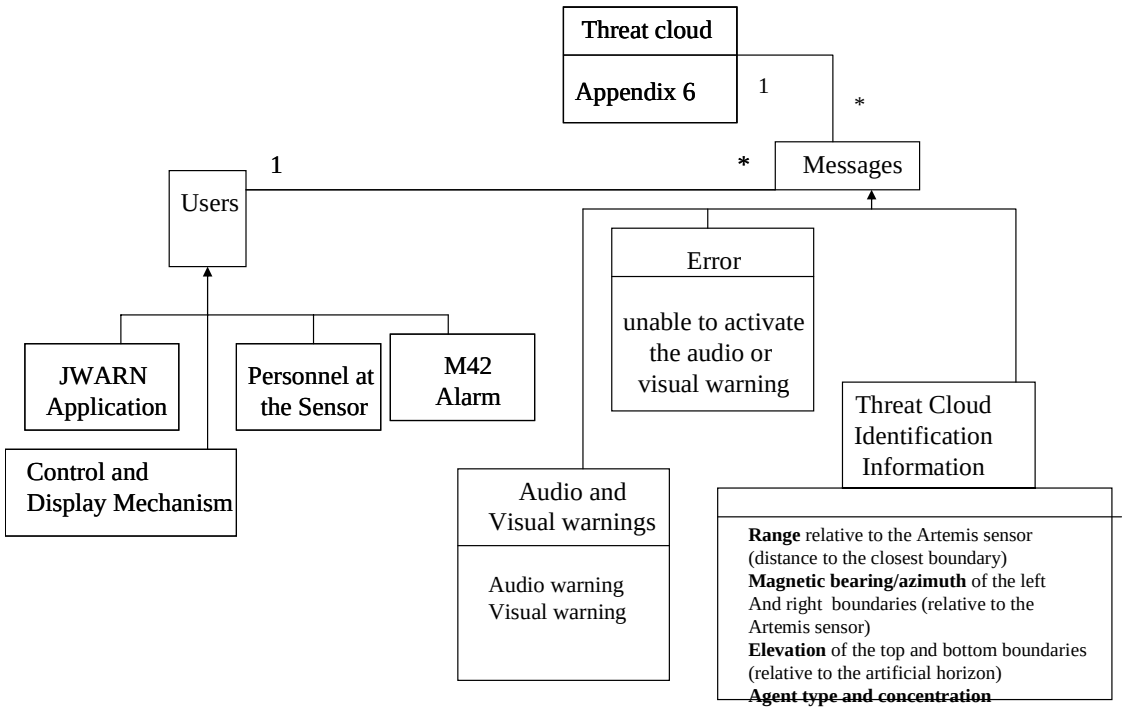


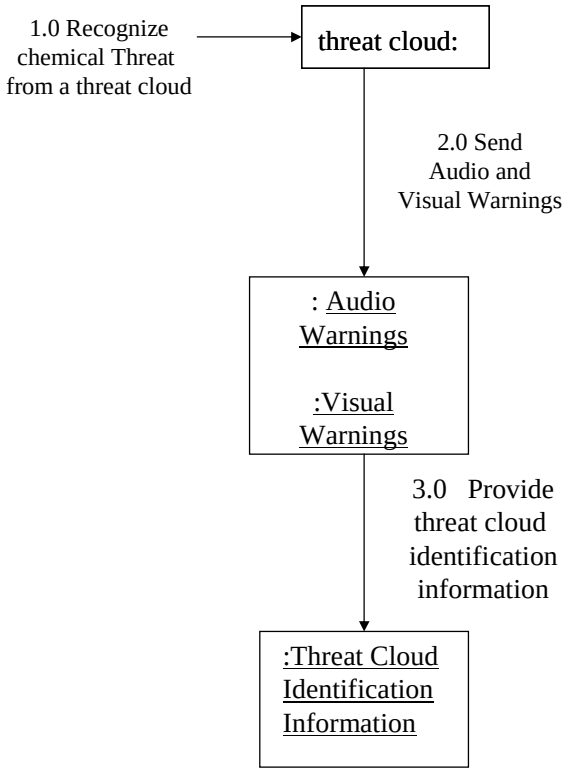


Use Case Diagram: Defines Scenario
What will be done?

Activity Diagram: Defines System Response
How will it be done?

Architecture Use Case Development Example (2)
Detection, Identification and Reporting a Threat Cloud

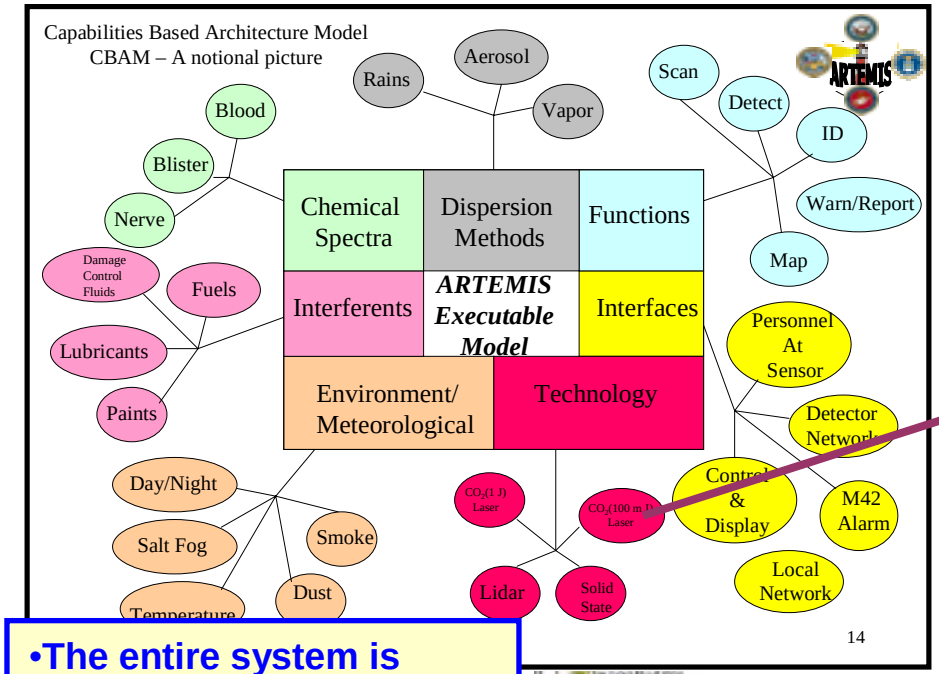


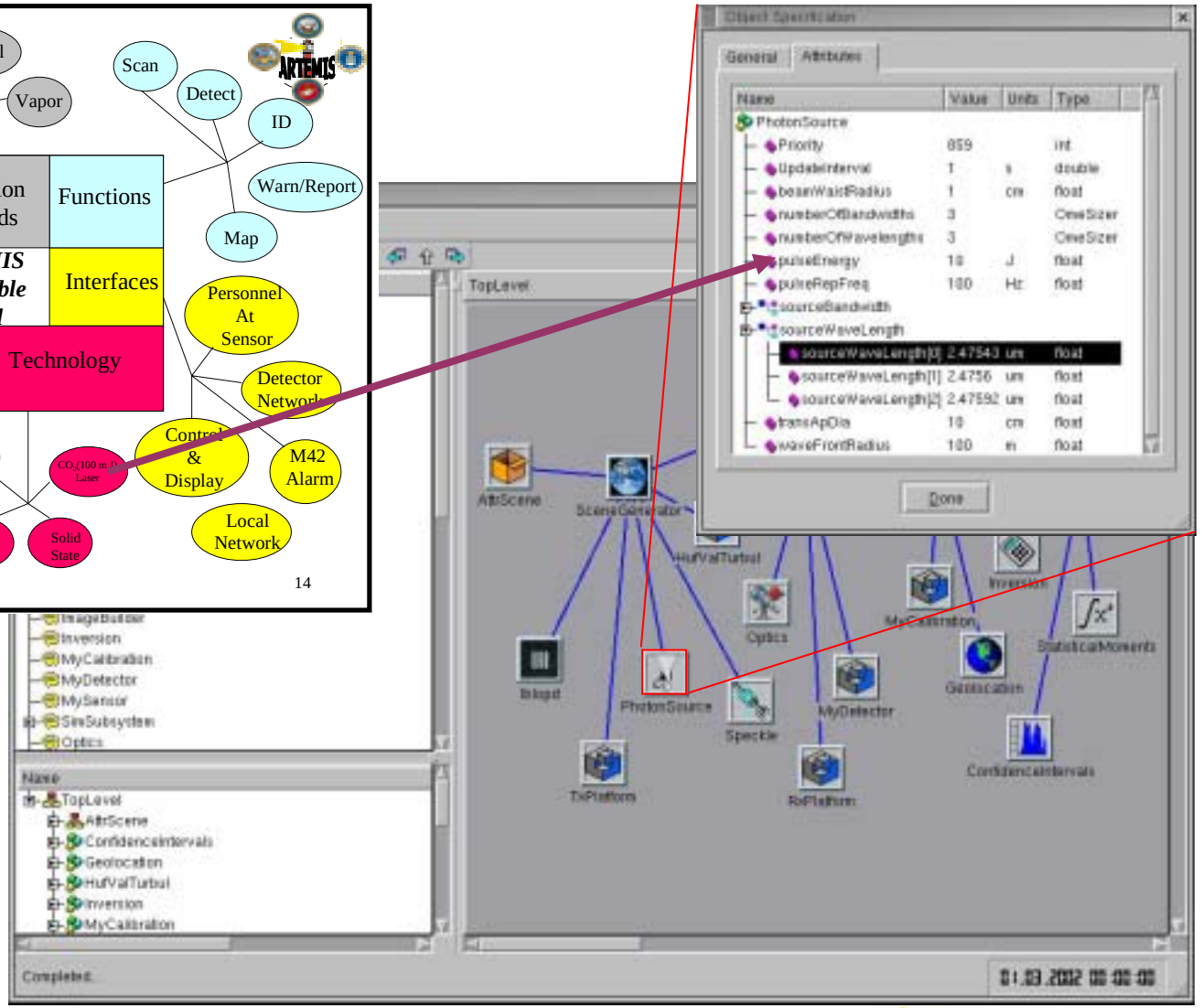


Class Diagram: Defines Players and Functions
Who does what?

Collaboration Diagram: Defines Interfaces
Where will it be done?

The Design of the Executable Model is Derived Directly from the Completed Architecture



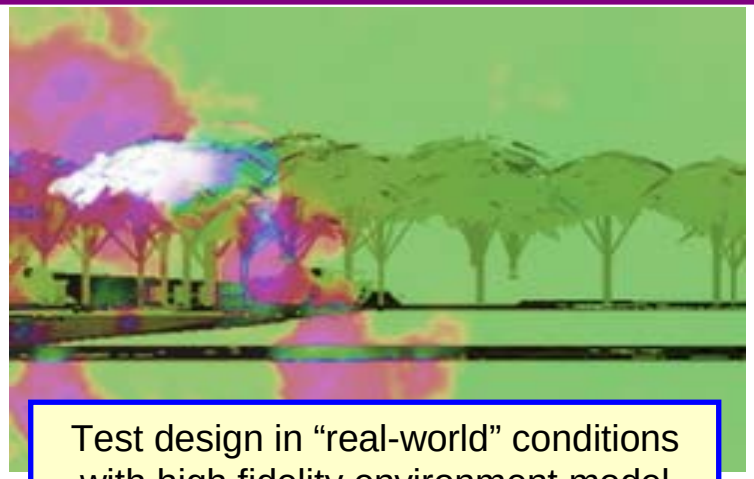


- **The entire system is represented by unique functional blocks**
- **Tools are built as modules contained in dynamic link libraries**
- **The attributes of each module define its characteristics**

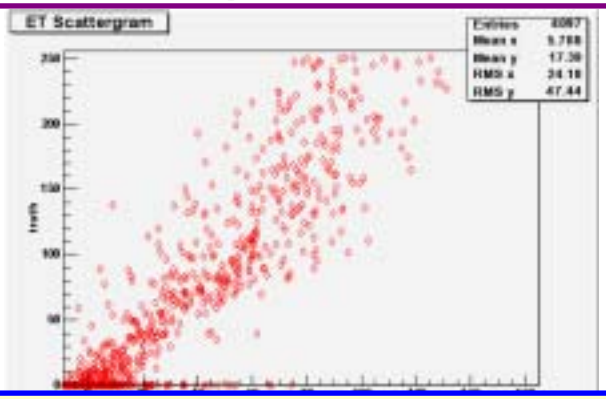
What is the Artemis Capabilities-Based Architecture Model (ACBAM)

- High fidelity, object-oriented system simulation of active standoff detectors
- Implemented using ITT Industries SPEED toolbox
  - Uses OmeChron simulation environment
  - Mimic the way a systems engineer may draw a block diagram of a system.
  - Mimic the way the physical phenomena occur within the system.
  - Utilizes time and event based execution models
  - Hierarchical architecture and inheritance enables multiple fidelity implementations
- Integrates “best of the best” models into a single system evaluation
  - DIRSIG for complex 3D spatial and spectral background representations
  - Radiative transfer: LBLRTM using HITRAN and PNNL databases
  - VLSTRACK for target cloud dispersion
  - Various sensing subsystem models reused from past developments

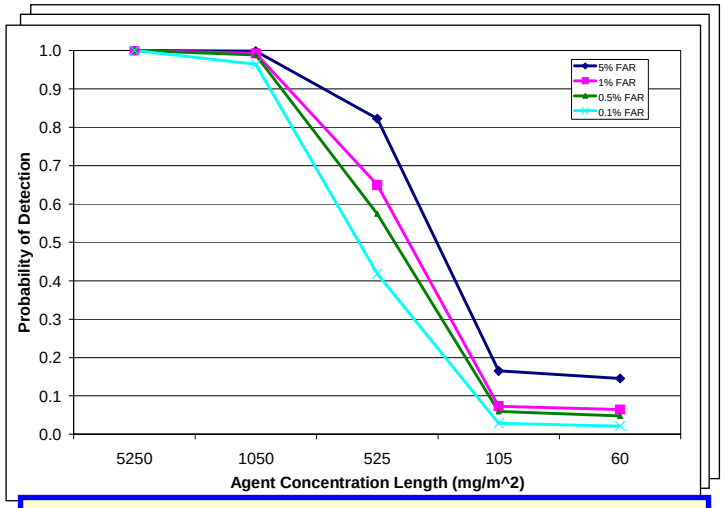
ACBAM Enables Design Optimization, Performance Evaluation and Test Troubleshooting



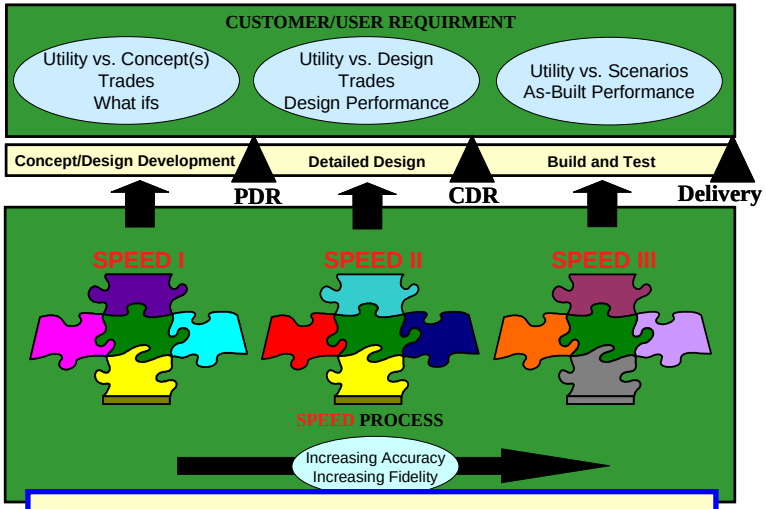
Test design in “real-world” conditions with high fidelity environment model



Evaluate algorithms and product quality with realistic instrument output

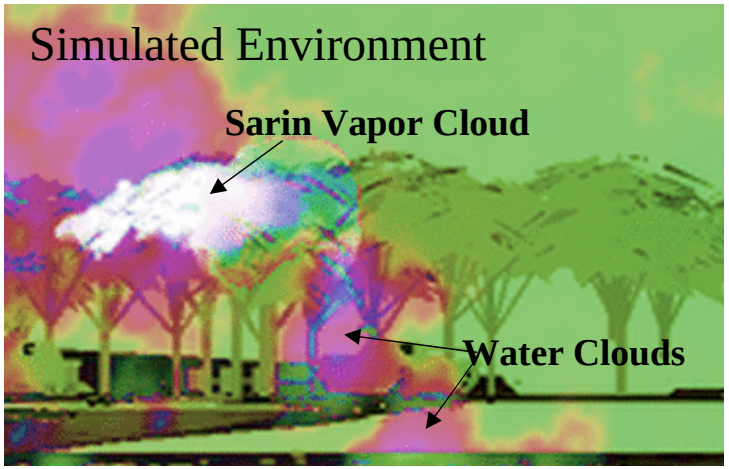


Explore Trade Space through multiple parameter studies

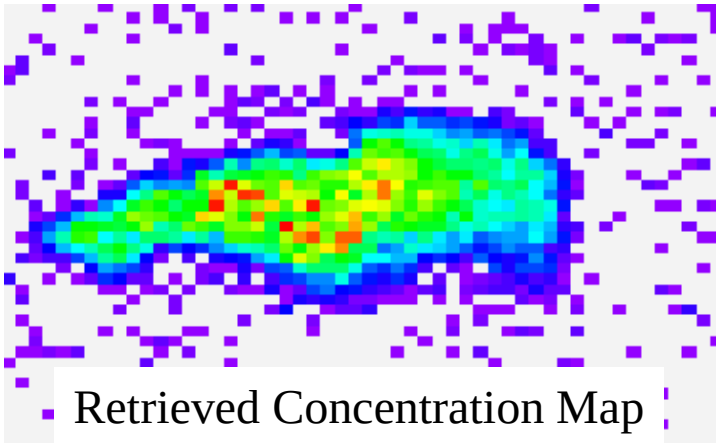


Simulation fidelity can increase as system design matures

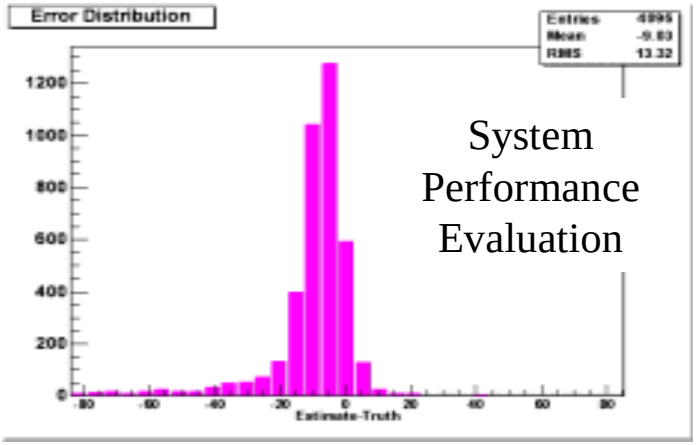
ACBAM Beta Version is Currently in Test – Initial Full Version Release in 12/03



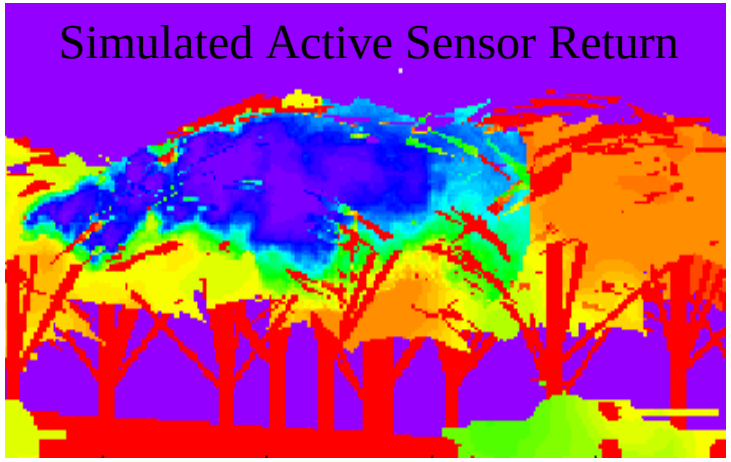
Processing of on and off absorption line spectral channels to estimate gas concentration



Performance assessment of specified system configuration



Complex 3D environment interrogated and sensed by active sensor



ACBAM Will Continue to Evolve to Support Program Needs Throughout the Life Cycle

- Post Milestone A
  - System Requirements Definition
  - ACBAM captures the logic, behavior, performance and effectiveness of the system utilizing proposed technologies
  - **ARE WE DEVELOPING THE RIGHT SYSTEM?**
- Post Milestone B
  - System Development and Demonstration
  - ACBAM will evaluate proposed design solutions, propose "best value testing" and predict test results
  - **ARE WE DEVELOPING THE SYSTEM RIGHT?**
- Post Milestone C
  - Production, Deployment, Operations and Support
  - ACBAM will evaluate production solutions, emerging technology, new design solutions and CONOPS changes
  - **WHAT IS THE VALUE AND RISK OF CHANGE?**